14.6%, $P = .05$), female gender (43.7% vs 22.0%, $P = .01$), and preoperative statin use (45.8% vs 75.6%, $P < .001$). There were no differences with respect to other comorbidities, including smoking status, presence of diabetes, renal insufficiency, anatomic factors, or open vs endovascular treatment. Ninety-seven patients underwent endovascular revascularization. The following outcomes were noted in the endovascular subset of LI and HI patients, respectively: primary-assisted patency was 71% vs 66% (P = NS), and 12-month cost per day of patency was \$166.30 ± \$77.40 vs \$22.45 ± \$12.45 ($P = .05$). Ninety-eight patients underwent open revascularization, with the following outcomes in LI and HI patients respectively: primary assisted patency was 78% vs 86% (P = NS), and the 12-month cost per day of patency was \$319.43 ± \$225.44 vs \$40.47 ± \$4.63 ($P = .07$). Amputation was eventually required in 19 of the 77 patients with critical limb ischemia. Multivariate analysis demonstrated that HI was protective against limb loss (odds ratio, 0.06; 95% confidence interval, 0.01-0.51; $P < .001$).

Conclusion: In patients undergoing femoropopliteal revascularization, income level correlates with advanced disease state presentation, advanced age (possibly a proxy for delayed presentation), and lack of statin use. Although the primary-assisted patency rate is not affected by income status, LI patients demonstrate an increased cost per day of patency and inferior limb salvage compared with HI patients. To our knowledge, these data are the first to establish a relationship between income and metrics of lower extremity revascularization success and demonstrate the financial and clinical burden associated with caring for these patients.

Prospective Randomized Trial of Routine vs Selective Shunting in Carotid Endarterectomy Based on Stump Pressure

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Background: The use of shunting in carotid endarterectomy (CEA) is controversial. Only a few randomized trials have compared routine vs selective shunting; however, none were based on stump pressure (SP). To our knowledge, this is the first randomized trial to compare the results of routine (RS) vs selective shunting (SS) based on SP.

Methods: The study randomized 200 CEA patients under general anesthesia into RS (n = 98) and SS (n = 102), where shunting was used only if systolic SP was <40 mm Hg (SSP). All patients had immediate and 30-day postoperative duplex ultrasound imaging. Analysis was done based on intention to treat.

Results: Shunting was used in 29 of 102 SS patients (28%). Clinical/demographic characteristics were comparable in both groups. Indications for CEA were also similar (42% symptomatic for RS vs 47% for SS, $P = .458$). The mean internal carotid artery diameter was also comparable (5.5 vs 5.5, $P = .685$). The mean preoperative ipsilateral and contralateral stenosis was 76% and 38% for RS ($P = .268$) vs 78% and 40% for SS ($P = .528$), respectively. The mean preoperative ipsilateral and contralateral stenoses were 79% and 56% in the shunted ($P = .634$) vs 78% and 34% in the nonshunted subgroup of SS patients $P = .002$), respectively. The mean SSP was 55.9 in RS vs 56.2 mm Hg for SS ($P = .915$). The mean SSP in the shunted vs non-shunted subgroup of SS was 33 vs 65 mm Hg ($P < .0001$). Mean clamp time in the nonshunted SS subgroup was 32 minutes. Mean shunt time was 35 minutes in RS vs 33 minutes in SS ($P = .354$). Mean operative time was 113 minutes for RS and 109 minutes for SS ($P = .252$) and 111 minutes in shunted and 108 minutes in the nonshunted subgroup ($P = .586$). Mean arteriotomy length was 4.4 cm for RS and 4.2 cm for SS ($P = .213$). Perioperative stroke rate was 0% for RS vs 2% for SS, consisting of one major and one minor stroke (neither patient was shunted; $P = .498$). No perioperative deaths occurred. The combined perioperative transient ischemic attack and stroke rates were 2% in RS vs 2.9% in SS ($P = 1$). The overall perioperative complication rates were 8.3% in RS (2 transient ischemic attacks, 3 bleeding, and 1 myocardial infarction, and 1 asymptomatic carotid thrombosis) vs 7.8% in SS (2 strokes, 1 transient ischemic attack, 3 bleeding, 1 myocardial infarction, and 1 congestive heart failure; $P = .917$).

Conclusions: Perioperative stroke/overall complication rates were somewhat similar for RS and SS based on SSP of <40 mm Hg.

Maximal Venous Outflow Velocity: A Novel Technique for Detecting Iliocaval Occlusive Disease

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Background: Compression of the left iliac vein by the overlying right iliac artery (May-Thurner Syndrome [MTS]) can cause left leg swelling due to outflow obstruction, increasing the risk for deep vein thrombosis. Discerning pathologic anatomy from normal iliocaval anatomy can be challenging, as planar imaging provides anatomic rather than functional information. Traditional duplex ultrasound (DU) interrogation of the leg provides data limited to only the infrainguinal venous system. Our hypothesis is that DU-derived maximal venous outflow velocity (MVOV) can be a useful screening tool as an adjunct to lower extremity DU to screen for patients with iliocaval obstruction.

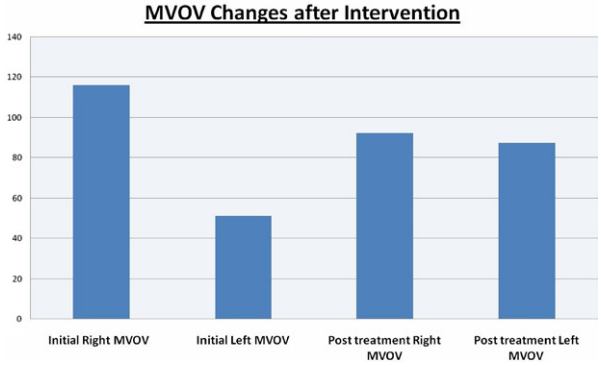

Fig 1. Maximal venous outflow velocity *(MMOV)* changes after intervention.

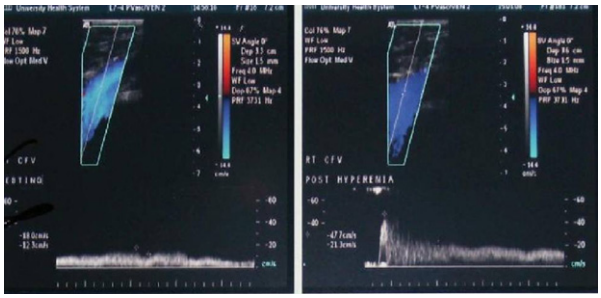

Fig 2.

Methods: MVOV studies of 14 patients with unilateral leg swelling from 2000 to 2009 were compared with a control group of 30 asymptomatic volunteers. Right and left legs of the test group and symptomatic and asymptomatic legs were compared with each other and with controls using the t test. A ratio of symptomatic to asymptomatic extremities was compared to left over right in the controls to generate an index compatible with pathologic venous impedance. The same parameters were also compared after endovenous stenting for positive venographic findings in patients with MTS.

Results: Symptomatic extremities had reduced absolute MVOVs ($P = .021$) compared with the contralateral extremity. In four patients undergoing endovascular stenting for MTS, a significant increase in MVOV of the treated leg was observed ($P = .012$), and the post-treatment MVOV measurements in the left and right legs were not significantly different ($P = .213$). On review, we found that a left-to-right MVOV index of <1.06 correlated with positive angiographic findings and success of treatment ($P = .0434$). In this same group, computed tomography with venous contrast predicted a positive venographic finding in 60% of the patients (3 of 5).

Conclusions: Because most patients with unilateral leg swelling undergo routine DU imaging to evaluate for deep vein thrombosis, MVOV studies can be obtained without added risk, exposure, and little technical cost. MVOV and a calculated index of <1.06 seems to be predictive of success of intervention, even when CT interpretation suggested otherwise.

Thoracic Endovascular Aortic Repair Does Not Alter the Natural History of Traumatic Aortic Disruption

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Background: Thoracic endovascular aortic repair (TEVAR) is an accepted treatment option for traumatic aortic disruption (TAD) despite little data on long-term outcome. We hypothesized that early TEVAR in patients with TAD would reduce deaths from aortic rupture in patients who arrive alive at the hospital.

Methods: We reviewed the medical records of 112 patients with TAD treated at a level I trauma center during a 10-year period. Medical examiner

autopsy reports were reviewed on all patients who died in the hospital to determine cause of death.

Results: Thirty patients (26%) were pronounced dead on arrival. Of the 82 alive patients, 33 (40%) died in the hospital. The mean injury severity score for patients who died was 43 ± 12 compared with 34 ± 12 for surviving patients ($P = .001$). In-hospital deaths were caused by aortic rupture in 12 patients (15%), other traumatic injuries in 19 (23%), and multisystem organ failure after aortic repair in two patients (2%). The 12 deaths from aortic rupture occurred ≤4 hours of injury: five died in the emergency department or computed tomography scanner, and seven died in the operating room. Aortic injury was recognized in only two of the seven patients who died intraoperatively and therefore represent the only patients who might have been salvaged with immediate TEVAR. Fifty-nine patients survived >4 hours with contained TAD, and eight (14%) died of associated injuries. Nineteen (32%) underwent aortic repair (17 open, 2 TEVAR) ≤24 hours due to severe aortic disruption or minimal associated injuries. Two died of postoperative complications. Twenty-two patients (37%) had delayed repairs (13 open, 9 TEVAR) because of infectious complications or the need to treat other organ system injuries; all survived to discharge. The mean hospital length of stay after TEVAR was 30 ± 30 days, which was not different compared with 33 ± 27 days after open repair. Operative complications occurred in eight of 30 patients after open repair and in one of 11 after TEVAR (P = NS). Regardless of the repair type, seven of the 19 patients (37%) in this series who underwent repair ≤24 hours developed operative complications compared with two (9%) of the 22 who underwent delayed repair ($P = .08$). Of the 10 (17%) surviving patients with minimal TAD who were treated with β-blockade and observation, three have stable aortic injuries and seven were lost to follow-up.

Conclusions: Most patients with TAD who arrive alive at the hospital do not experience aortic rupture. Rupture appears to occur within the first 4 hours of admission, before the injury can be recognized in time for salvage with immediate TEVAR. No patient in this series who survived >4 hours died of aortic rupture. Death was related to the extent of associated injuries and was not influenced by the type or timing of repair.

Deglutition Syncope: A Manifestation of Vagal Hyperactivity Following Carotid Endarterectomy

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Background: Transient hypotension and bradycardia after carotid endarterectomy (CEA) is related to increased baroreceptor activity at the carotid bifurcation. These symptoms, mediated by afferent impulses through the nerve of Hering, result from increased vagal activity. We report a case of deglutition syncope after CEA.

Case report: A 61-year-old man presented with left amaurosis fugax and bilateral >80% internal carotid artery stenoses. His surgical history was significant for a right CEA 12 years previously. After an uneventful left CEA, he was hemodynamically stable and without neurologic deficits. On the first postoperative day, the patient experienced crushing chest pain, bradycardia, hypotension, and bilateral vision loss as he began to eat breakfast. Results of an electrocardiogram, computed tomography (CT) scan with pulmonary embolism protocol, cardiac isoenzyme analysis, and echocardiogram were normal. His blood pressure, chest pain, and vision loss responded initially to the administration of pressors. During the next day, similar symptoms developed each time he attempted to eat. With initiation of anticholinergic medication, he was able to eat without symptoms. Results of a barium swallow were normal. The patient's symptoms resolved, and the anticholinergic medication was discontinued. The patient underwent an uneventful right CEA 3 months later. He was hemodynamically and neurologically stable during the procedure and postoperatively. The morning after the CEA, diaphoresis, hypotension, and tachycardia again developed when he began eating breakfast. Anticholinergic medications were again initiated and all symptoms resolved ≤48 hours.

Results: The patient has been seen in follow-up. He has had no further episodes of deglutition syncope or other neurologic symptoms. His CEA are widely patent.

Conclusions: Increased vagal tone after CEA, mediated by hypersensitivity of the baroreceptors of the carotid sinus, is well described. The nerve of Hering, an afferent branch of the glossopharyngeal nerve, synapses with efferent fibers of the vagus nerve in the nucleus tractus solitarius within the medulla. The glossopharyngeal nerve also transmits afferent impulses from the esophagus. We hypothesize that after CEA, our patient had a transient increase in afferent activity to the nucleus tractus solitarius related to changes of the carotid baroreceptor. With additional glossopharyngeal afferent activity associated with swallowing, deglutition syncope developed. Deglutition syncope is considered an unusual manifestation of vasovagal episodes and usually has been reported in association with esophageal, cardiac, and thoracic aortic abnormalities. To our knowledge, this patient is the first case of deglutition syncope reported after CEA. Because deglutition syndrome can be associated with esophageal abnormalities, a barium swallow should be evaluated. Clinicians should be aware of and know how to address this rare complication of CEA.

Late Erosion of a Prophylactic Inferior Vena Cava Filter into the Aorta, Right Renal Artery, and Duodenal Wall

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Background: Prophylactic insertion of inferior vena cava filters (IVCFs) accounts for more than half of all IVCFs placed into multisystem trauma patients with contraindications to anticoagulation. The use of prophylactic IVCFs has increased in association with the introduction of retrievable IVCFs (R-IVCF), most of which are not removed. In this report we describe a patient with R-IVCF–related pseudoaneurysms of the infrarenal aorta and right renal artery who presented 10 months after multiorgan trauma and prophylactic R-IVCF placement. Management required autogenous aortic reconstruction, caval repair, and subsequent right nephrectomy.

Methods: A 42-year-old man presented with left upper extremity edema and was diagnosed with left arm thrombophlebitis. A computed tomography (CT) scan of the abdomen and pelvis was obtained as part of an evaluation of back pain. The CT demonstrated an IVC filter with struts protruding outside the vena cava lumen associated with fluid collections, an infrarenal aortic pseudoaneurysm, and penetration into the duodenal wall (Figs 1 and 2). A follow-up CT scan 3 days later demonstrated increased pericaval fluid collections and new septic emboli to the lungs. The patient's Celect R-IVCF (Cook Medical, Bloomington, Ind) had been placed 10 months earlier for pulmonary embolus prophylaxis in the absence of documented deep vein thrombosis after a motor vehicle accident associated with multiorgan injuries. At the completion of his trauma hospitalization, an attempt to retrieve the filter was unsuccessful and it was left in place. After a second unsuccessful attempt to remove the filter percutaneously, we proceeded with open removal of the R-IVCF requiring retrohepatic caval control, bilateral renal vein control, and infrarenal caval control. One filter strut was imbedded in the duodenal wall but had not entered the lumen. The aortic pseudoaneurysm was repaired using a femoral-popliteal vein interposition graft. The patient was discharged home on postoperative day 20. Follow-up contrast CT demonstrated a right renal artery pseudoaneurysm (Fig 3) that was not present on the preoperative CT. Arteriography demonstrated a pseudoaneurysm arising from the right main renal artery bifurcation at the previous location of one of the filter struts. The patient was not considered a reasonable candidate for renal salvage and was managed with embolization, followed by right nephrectomy.

Results: The patient is doing well at the 3-month follow-up, with normal renal function. He is asymptomatic, with evidence of patency of his IVC and aortic repair.

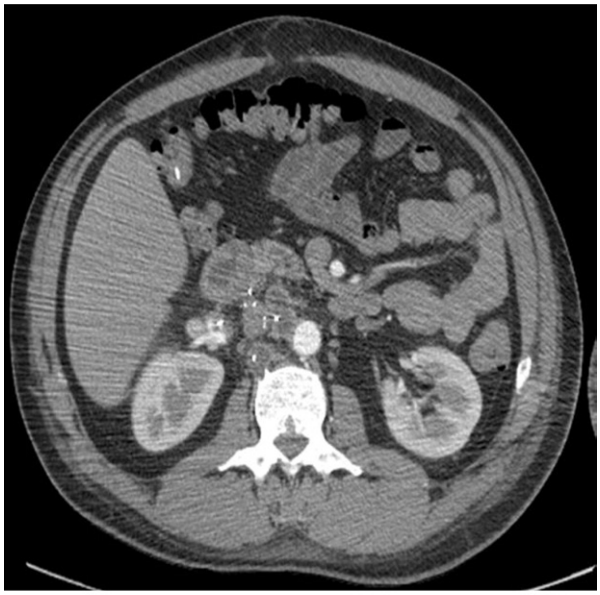

Figure 1: Extraluminal struts from a retrievable IVC filter with associated fluid collections, infrarenal abdominal aortic pseudoaseurysm, and involvement of the duodenal wall.

Fig 1. Computed tomography scan shows extraluminal struts from a retrievable inferior vena cava filter with associated fluid collections, infrarenal abdominal aortic pseudoaneurysm, and involvement of the duodenal wall.